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ABSTRACT

This report presents examples of statistics on higher education which are collected by the National Science Foundation (NSF). Data are presented from the four annual university surveys conducted by NSF. These concern (1) graduate student enrollment and support, (2) academic research and development expenditures, (3) professional and technical employment, and (4) Federal obligations to institutions of higher education. The reporting and processing characteristics of NSF surveys are discussed, and the quality of the data gathered is examined. Data analysis and presentation in the past have used descriptive statistics primarily, but future plans call for more analytical treatments. NSF plans to have an integrated computerized data base in operation by 1976, and to encourage educational researchers to use the data. Small grants will be available to persons conducting studies of educational policy. (SD)

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NSF UNIVERSITY STATISTICS
ANALYTICAL USES FOR EDUCATIONAL RESEARCHERS

by

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National Science Foundation

Presented at the session on: "NSF Statistical Indicators: Implications for Educational Researchers" at the Annual Meeting of the American Educational Research Association

San Francisco, California
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I am pleased to be here today to talk with you about the NSF University Statistics Program. As part of my presentation, I will be describing a new grant program we are considering that would be aimed at educational and other researchers using an integrated data file of four annual surveys. George Nozicka of Moshman Associates will talk about the technical aspects of the file, and Ivars Zageris of the American Council on Education will address the group on uses of the data at the National Institutes of Health (for William Copeland who could not be with us) and by a Presidential Commission for Biomedical Research. Finally, we are pleased to have Dr. David Drew of the RAND Corporation as discussant.

Let us turn to a discussion of examples of the higher education statistics that NSF collects on an annual basis. I will refer later to these data in terms of timeliness, quality, and their relevance to some important policy issues in higher education. Generally, the NSF university statistics program consists of four annual surveys of graduate student enrollment and support, academic R&D expenditures, professional and technical employment, and Federal obligations to institutions of higher education. Together, they provide a consistent time series of statistical data on various characteristics of university science.

SURVEY OF GRADUATE STUDENT SUPPORT AND POSTDOCTORALS

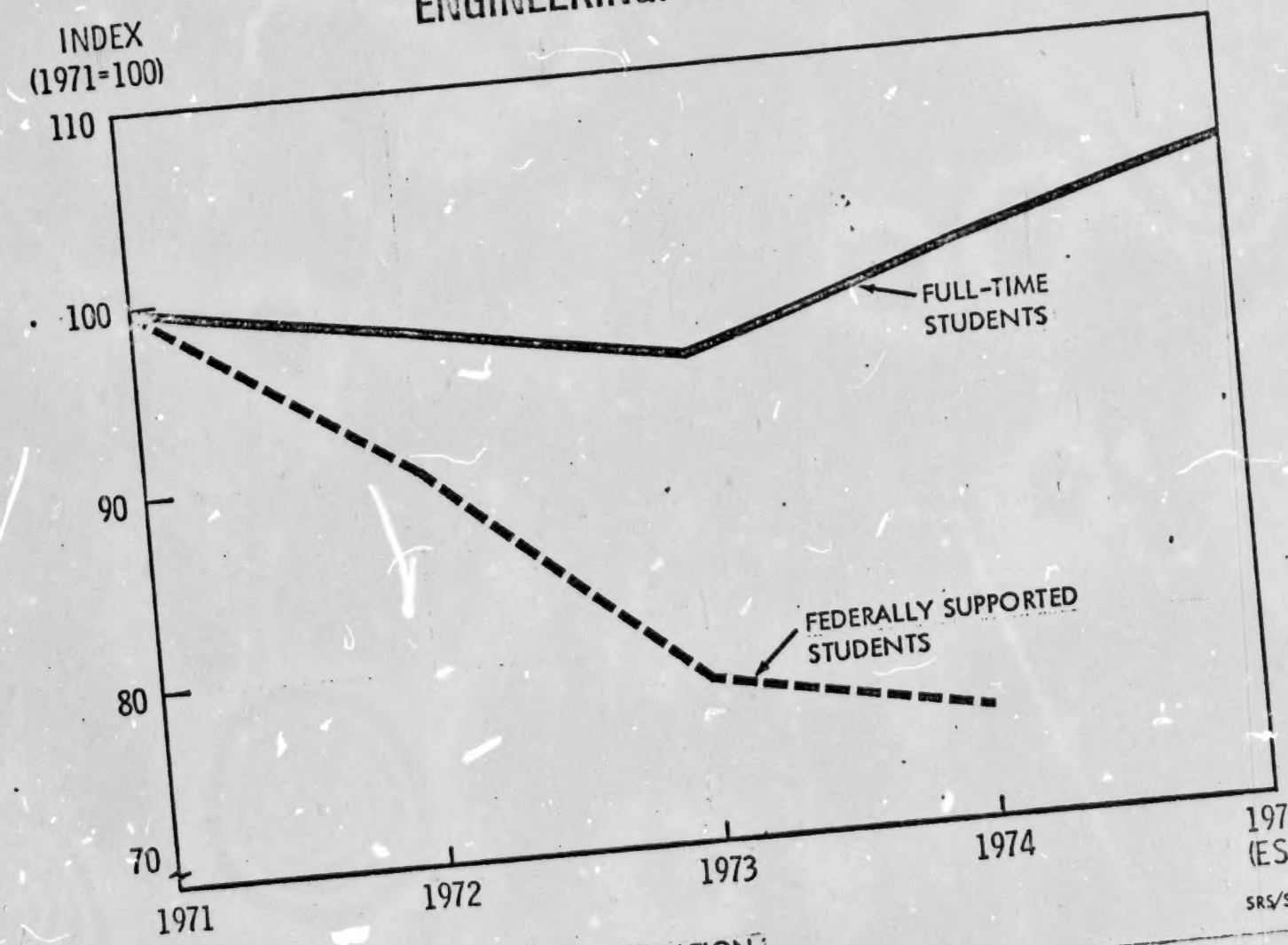
The first survey I will discuss, the survey of graduate student enrollment, covers approximately 7,500 departments of science and engineering in Ph.D. granting institutions. The data elements for full-time students are the mechanisms of support such as research assistantships, level of

graduate study, Federal agency sources of support, non-Federal sources, and foreign students. Other data items are part-time enrollment, number of G.I. benefit recipients, and postdoctorals and their sources of support.

One very significant characteristic of the survey is that it presents a profile of the effects of new Federal educational policy and the resulting impact on graduate education. For example, Chart 1 shows a steady drop in the number of full-time graduate science students who were primarily supported by Federal funds. Up until two years ago, the total number of students also declined. Many factors contributed to the declines, including shrinking job markets for Ph.D.'s in a number of scientific occupations, increased costs of higher education, abolition of military draft deferments, as well as curtailment of Federal grants for fellowships and traineeships.

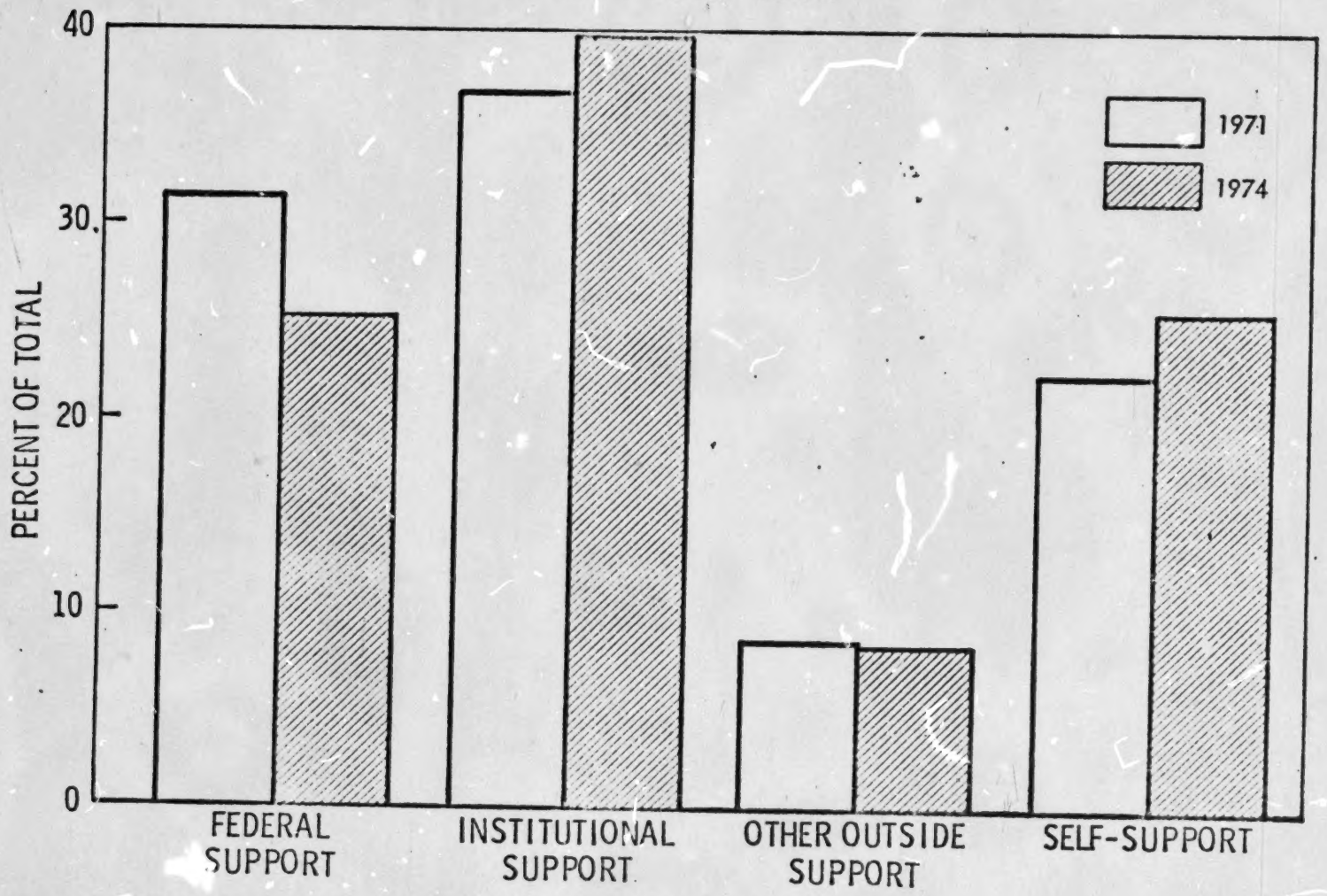
Beginning in 1974, we experienced a two-year increase in graduate enrollment, even though Federal support continued its decline. Among the most important factors leading to the increase were the recessionary economy and unfavorable employment conditions. Many of the recent college graduates were unable to find suitable employment in tight job markets and to continue their education, the students turned to private sources, college scholarships and their parents, for instance. These shifting sources of support are shown in the next chart--now institutional and self-support are the main sources for more than two-thirds of all full-time graduate science students (Chart 2).

TRENDS IN FULL-TIME GRADUATE ENROLLMENT AND FEDERAL SUPPORT IN THE SCIENCES AND ENGINEERING: 1971-75



SOURCE: SRS/STIA, NATIONAL SCIENCE FOUNDATION

2 DISTRIBUTION OF FULL-TIME GRADUATE SCIENCE STUDENTS, BY SOURCE OF MAJOR SUPPORT, 1971 AND 1974



SOURCE: SRS/STIA, NATIONAL SCIENCE FOUNDATION.

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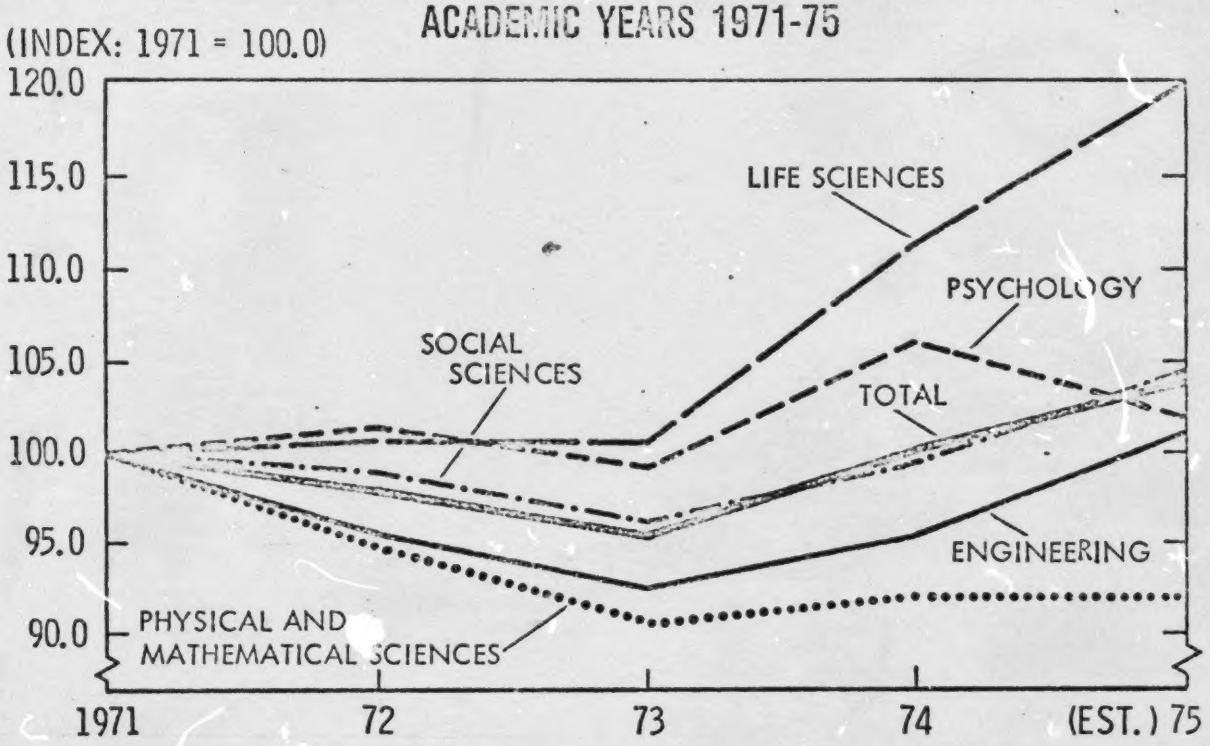
The survey also produces analysis of trends in graduate student enrollment in various fields of science (Chart 3). The life science fields have shown the greatest rates of increase in recent years. These fields of study have growing appeal among young adults in terms of their occupational aspirations and several years ago, significant increases were noted in junior year enrollment in the life sciences and health professions. Many of these students were hoping to enter medical school but only about one of three were successful. Among the unsuccessful ones were those who enrolled in graduate school in a related field in the life sciences.

SURVEY OF ACADEMIC R&D EXPENDITURES

Turning now to the next survey--the academic R&D expenditure survey--it obtains data from about 600 colleges and universities that are performers of sponsored research. The expenditures survey covers separately budgeted research by sources of funds, by type of activity such as basic and applied research, and by fields of science. Instruction and departmental research, and capital expenditures by field of science are also collected.

Chart 4 serves as an example of the kind of data we get from the academic R&D expenditure survey. Total R&D expenditures increased steadily since 1964 in current dollars. By 1975, they grew to almost three-times their level a decade ago. In constant dollars, however, they remained at roughly the same level as 1968 and in two periods, the rates of inflation exceeded any increases. Except for 1974,

3 FULL-TIME GRADUATE ENROLLMENT BY AREA OF SCIENCE: ACADEMIC YEARS 1971-75



SOURCE: DIVISION OF SCIENCE RESOURCES STUDIES/STIA

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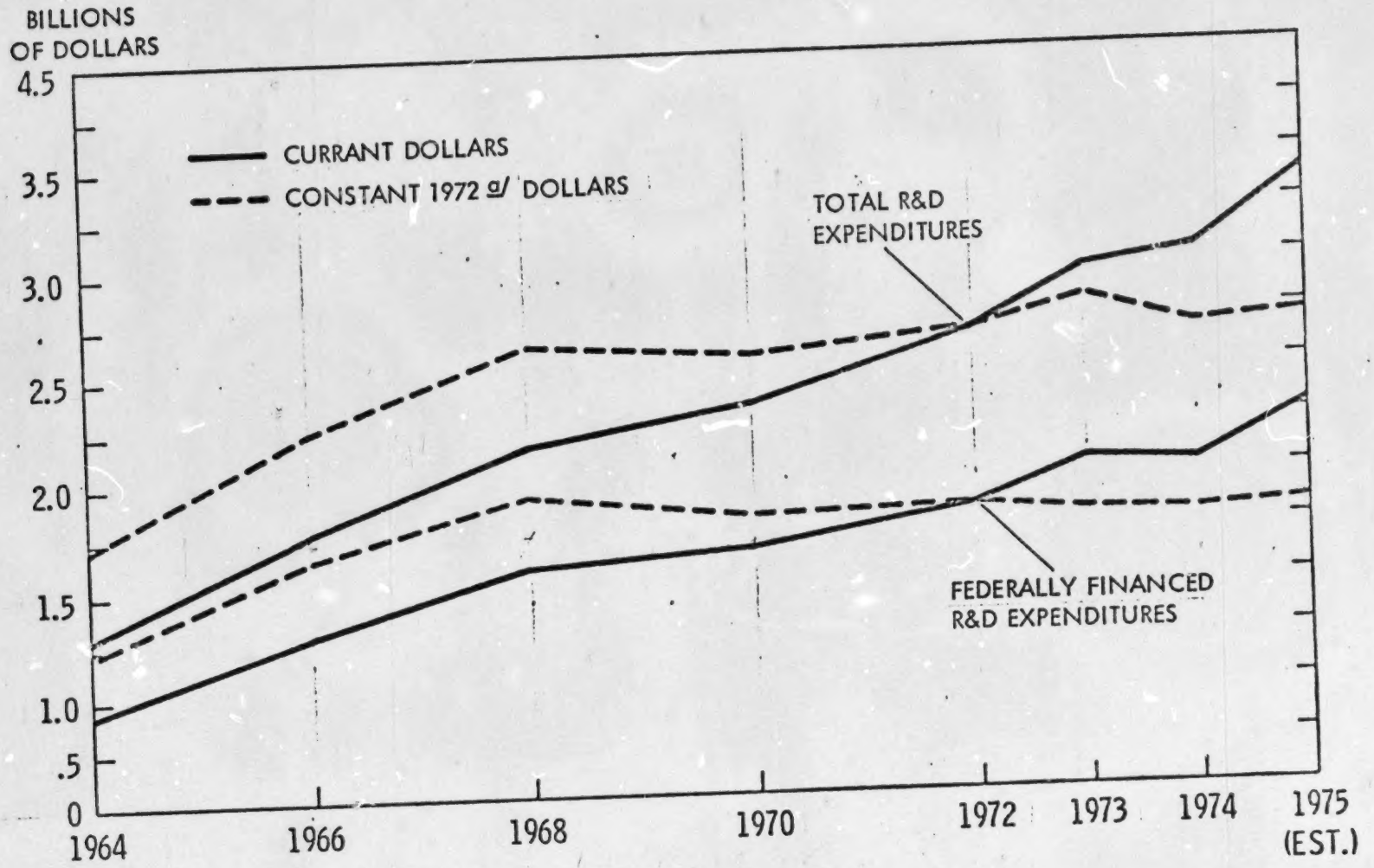
4

R&D EXPENDITURES OF UNIVERSITIES AND COLLEGES: FY 1964-75



a/ BASED ON GNP IMPLICIT PRICE DEFLATOR.

SOURCE: SRS/STIA, NATIONAL SCIENCE FOUNDATION

SRS/STIA-4/1

6

Federal support also increased in each period in current dollars. The dip in 1974 was due to impoundment by OMB of discretionary R&D funds appropriated to HEW. When these impounded funds were released through court action, a substantial increase of 12 percent resulted in 1975. A real increase of three percent occurred also, even with spiraling rates of inflation.

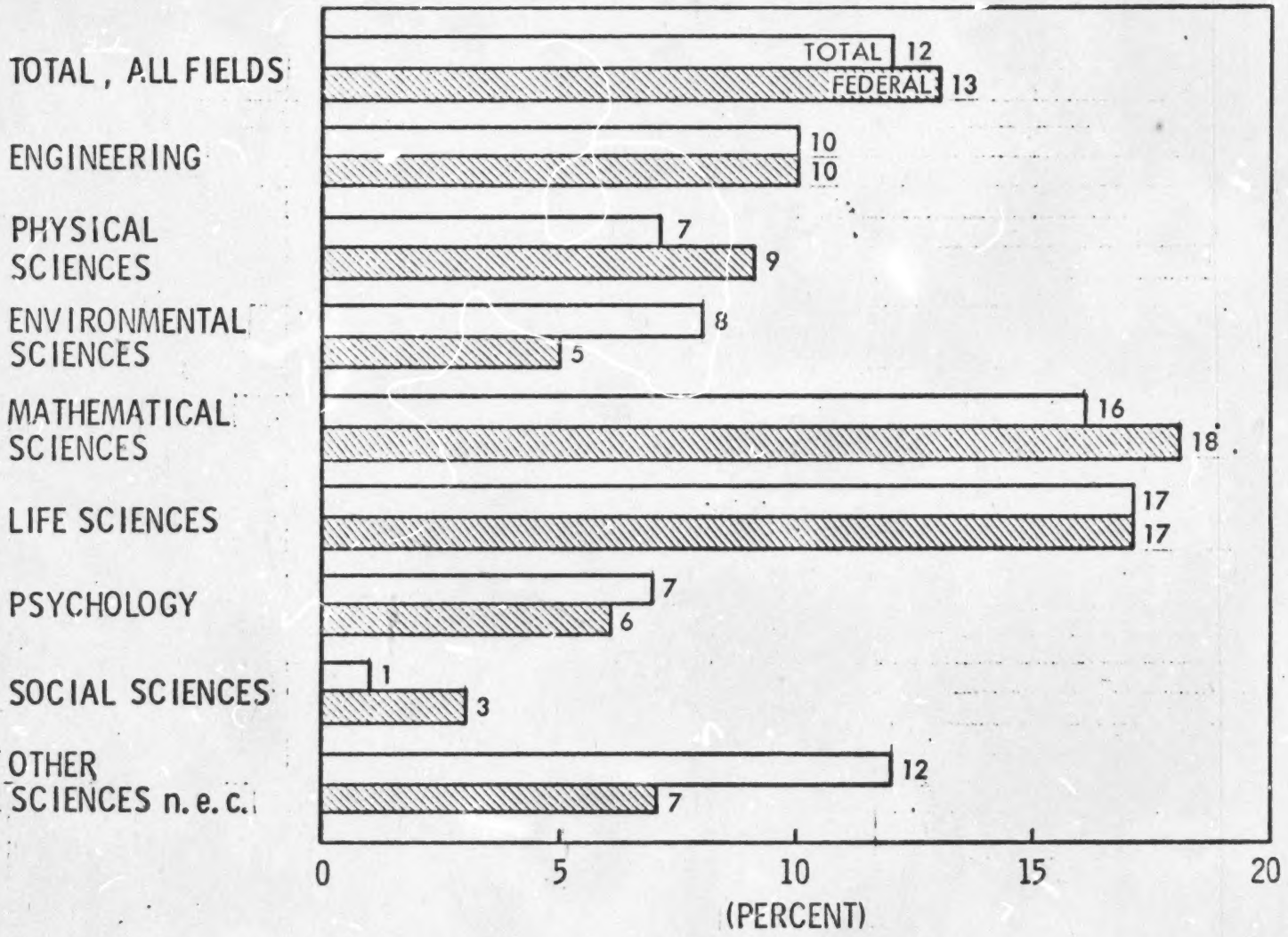
The main impact of the release of impounded funds was felt in the medical sciences when NIH obligated about $150 million of these dollars. As a result, medical research in academe went up almost 20 percent in terms of Federal support (Chart 5).

SURVEY OF FEDERAL AGENCY OBLIGATIONS TO ACADEMIC INSTITUTIONS

Another way to look at the financial picture is from the standpoint of Federal agency obligations. The term "obligation" is used in Federal accounting and means that a total award is entered on the books at the point of the legal commitment. The actual expenditures by the institutions occur later; perhaps, even several years later, depending on the type of award. In this survey, 14 Federal agencies report to NSF on their funding to each educational institution. The statistics are published by institution and agency by various categories of support, such as R&D and R&D plant, and by field of science.

Because of the lag, the obligations data are important in projecting year to year changes in Federal support to academic institutions. For example, look at the slope of the curves in the next chart (Chart 6),

5 R&D EXPENDITURES AT UNIVERSITIES AND COLLEGES, BY FIELD OF SCIENCE: FY 1974-75



SOURCE: SRS/STIA, NATIONAL SCIENCE FOUNDATION

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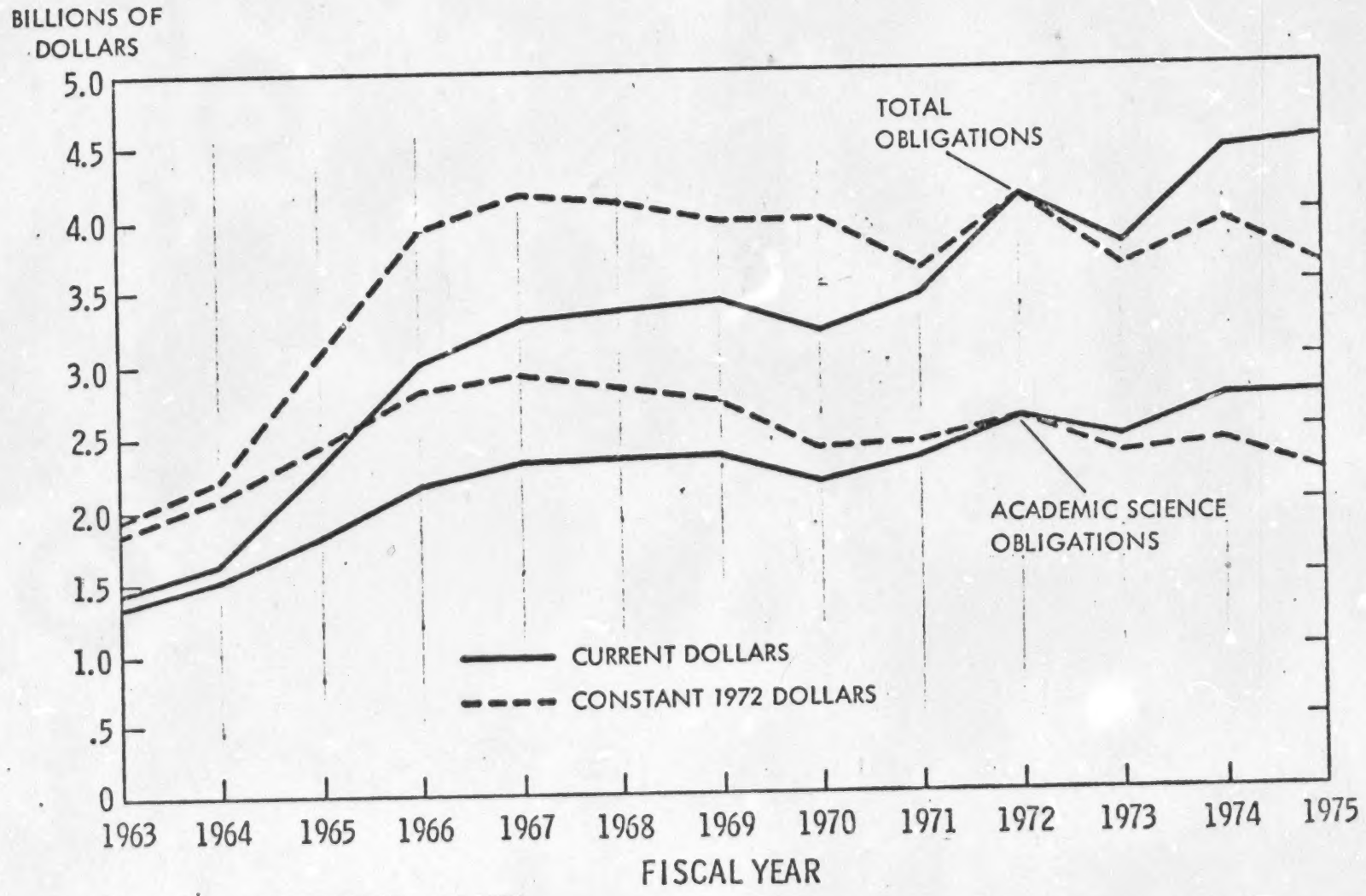
6 TRENDS IN FEDERAL OBLIGATIONS TO UNVIVERSITIES AND COLLEGES: FY 1963-75 a/



a/ PRELIMINARY ESTIMATES FOR 1975

SOURCE: SRS/STIA, NATIONAL SCIENCE FOUNDATION

SRS/STIA-4/1

from 1972 to 1973 and 1973 to 1974. They go down in the first period during the impoundment process and jump up in the next year. They match very closely the corresponding trend lines that we saw in the expenditure survey charts a year later. And using the same analysis, because of the very small increment in the Federal obligations in 1975, we can expect a leveling off of the 1976 academic R&D expenditures, with actual decreases in real terms. In 1977, however, the R&D budget is slated for an 11 percent increase, compared with an average 5.5 percent increase in other federally supported activities.

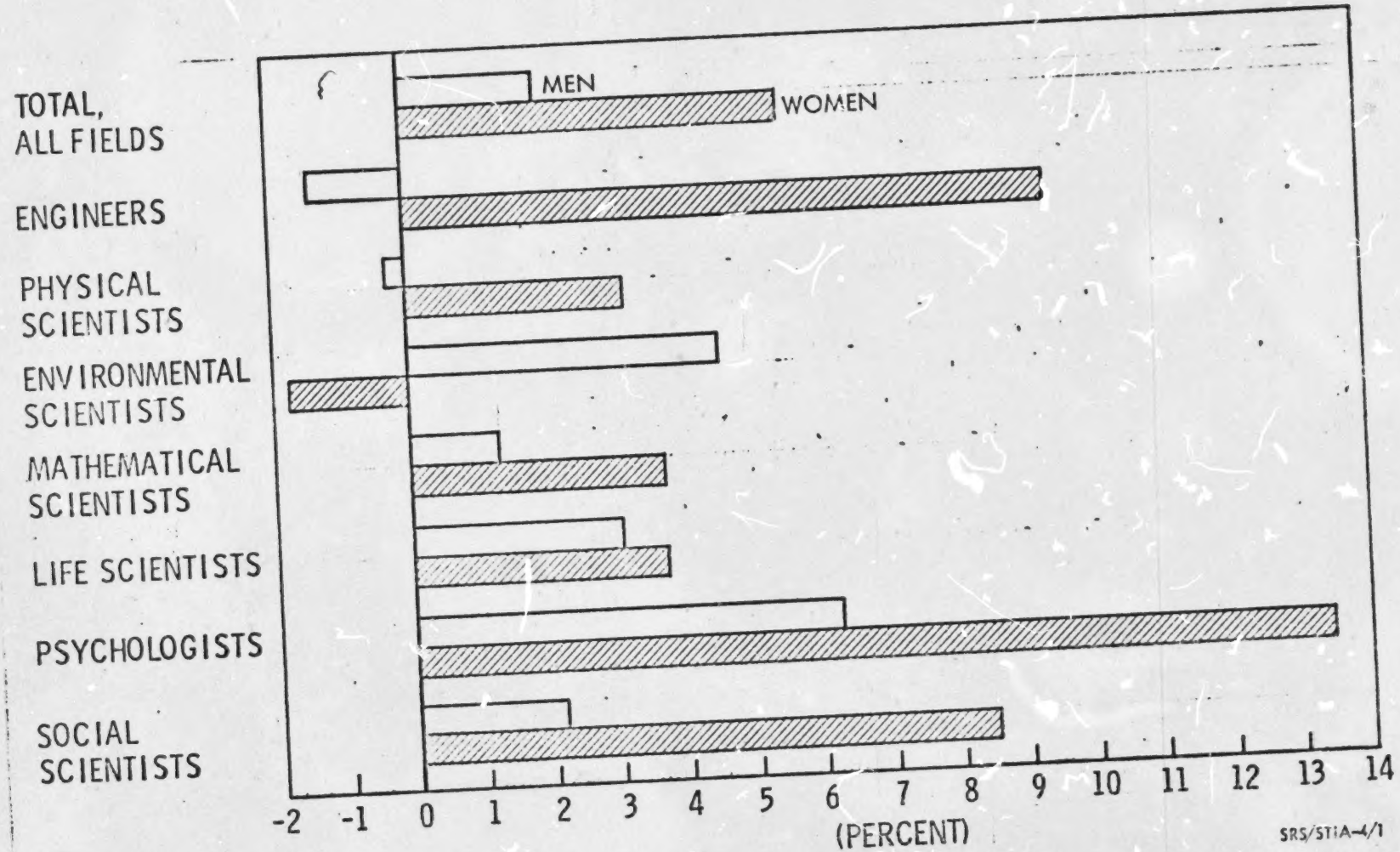
SURVEY OF EMPLOYMENT OF SCIENTIFIC AND TECHNICAL PERSONNEL

The fourth and last survey covers scientific and technical personnel. The manpower survey consists of about 2,200 colleges and universities that report information on fields of employment, functions in which primarily employed (such as research and teaching), highest earned degree, and sex.

(7)

The next graph is an example of these personnel data and it shows that 1975 employment of full-time scientists and engineers in higher education increased nearly three percent over the 1974 level to a new high of almost 240,000. Part-time employment jumped 10 percent, also a new high. Despite fiscal crises, S&E employment continues to grow, although at a much slower rate than was reported in the 1960's. These data serve to illustrate the point that the behavior of academic institutions under differing conditions of growth and deceleration is not symmetrical. As all of you know who are faced with the problem of keeping university accounts in the black, contraction is a much slower and more difficult process than expansion.

7 CHANGE IN EMPLOYMENT OF FULL- TIME SCIENTISTS AND ENGINEERS AT UNIVERSITIES AND COLLEGES, BY FIELD AND SEX, JANUARY 1974-75



SOURCE: SRS/STIA NATIONAL SCIENCE FOUNDATION

Employment of women scientists and engineers is increasing at almost triple the pace of men during 1975, probably reflecting the emphasis placed on affirmative action dealing with sex descrimination. One should remember, however, that despite recent gains, the proportion of women scientists and engineers comprises only 15 percent of full-time academic employment in these fields.

REPORTING AND PROCESSING CHARACTERISTICS

I would like to turn briefly to a description of some of the reporting and processing characteristics of the NSF academic surveys in terms of broader Federal statistics collection issues. First, the NSF data are timely, the graduate student data covering the current academic semester and the others being within one year of the survey period. This contrasts markedly from some other Federal surveys where, in certain cases, delays between collection and publication have been as long as three to four years.

The most substantial issue we face is quality of the data. Although our response rates are excellent--approaching 90 to 100 percent in most of the surveys--many of the quality problems are conceptual. Record-keeping practices of universities often do not correspond to the statistical concepts embodied in our questionnaires and, after all, the idea of accountability is still fairly new to most academic institutions. We have invested considerable resources into the quality problem--reliability and validity checks in the field, advisory panels of experts, national conferences, and plenty of data editing--but much more remains to be done before we are satisfied.

THE MOVEMENT TO ANALYSIS

The new, future emphasis of the NSF academic statistics program will be placed on analytical treatment of the data. In the past, with a few exceptions, most of the analysis has been descriptive. Some of the exceptions are David Breneman, who used the graduate student data to analyze the issue of shifting quality in enrollment in graduate departments [1/] and their use by the RAND Corporation in a model to try to measure the impact of Federal support on research in the biomedical sciences for a Presidential task force.

Of course, the data bases for the four surveys are in computerized formats for large-scale analytical treatment. The statistics have great potential of becoming a very valuable resource to researchers both within NSF and other groups, by providing an interface with the various commonly-used statistical analysis systems, such as the Statistical Package for the Social Sciences (SPSS). This so-called "integrated data file," providing interface with the data from the four surveys and the statistical analysis systems, is being developed presently for NSF by Moshman Associates.

Such an interface capability will be powerful, very flexible, and will permit analysis of many issues. Otherwise, the large size of the entire data base would cause its use for direct input into

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1/ Breneman, David. Graduate School Adjustments to the "New Depression" in Higher Education. February, 1975, National Academy of Sciences, Technical Report No. 3.

statistical analysis programs to be slow and expensive. The integrated data file will permit issues and research hypotheses to be studied that involve only a small fraction of the large amount of statistics in the entire file.

NSF is planning to have the integrated system in operation by the end of fiscal year 1976. The data base will be completed for four survey years. A Data Base User Manual will describe the integrated system contents, coding structures, and procedures for data extraction and analysis by academic researchers.

To encourage analysis by educational researchers of the NSF academic statistics from the four surveys, we hope to be able to launch a new program of small grants using data from the integrated data file. Among the various types of assistance that we might consider supporting under the new grant program are: (1) research that is relevant to some important policy issues in science and higher education; (2) development of models for understanding the dynamics of higher education; and, (3) dissertation research by doctoral candidates on science-related policy issues. We hope that budgetary funds will become available to support some of these grants next fiscal year, and when the details are worked out, we will be publishing appropriate grant guidelines.

CONCLUDING REMARKS

As you see, the NSF university statistics program represents many years and much effort of compiling extensive information on important characteristics of academic science. Four surveys of student enrollment, finances, and manpower form the computerized data bases. When these files are integrated, a great potential will be created to use these statistics in analyzing important policy issues in academic science. We hope that our plans materialize for a new grant program so that the wealth of data may be used by educational researchers to empirically examine these issues.